PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in and relating to Thermal Insulation

We, GENERAL ELECTRIC COMPANY, a Corporation of the State of New York, United States of America, having its office at Schenectady, 5, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a highly efficient thermal insulation housing structure or construction particularly for high temperature use.

For a number of years mats of fine glass fibres have been available for use as thermal insulation. While glass fibres are the best material available for many insulation applications, they may not be used at temperatures above the softening point of glass without destroying the insulating properties of the fibres. Mineral fibres which can withstand temperatures above the softening point of glass are much more expensive than glass fibres and are less satisfactory as insulators.

Accordingly, it is an object of this invention to provide a thermal insulation housing or panel in which mineral fibres such as glass fibres are incorporated without impairing the insulating quality of the panel when it is used at temperatures above the softening point of said fibres.

In such a composite insulation panel or housing which utilises glass fibres as part of the insulation material and heat-stable mineral fibres as the other part, silica fibres are employed on the side of the panel to be exposed to a high temperature and glass fibres are employed on the side of the panel to be exposed to a lower temperature.

Briefly stated, in accordance with one embodiment of our invention, we provide a pair of gas-imperious surfaces in spaced, sealed engagement, the surfaces defining an evacuated space, a blanket of high melting point mineral fibres in the evacuated space in engagement with one of the surfaces, and a blanket of mineral fibres having a lower melting point in the evacuated space in engagement with the other of the surfaces, the fibres being randomly oriented, each with its axis positioned generally parallel to the plane of the portion of the surface nearest the fibre.

The drawing is a broken sectional view of an insulation panel or housing made in accordance with our invention. A pair of surfaces 10 and 11 are sealed together in gas-tight engagement as shown at 12. The surfaces 10 and 11 may be made of a mineral substance such as quartz but the refractory nature of this material and the difficulty of fabricating it result in a preference being shown for gas-impervious metals. The various stainless steels available commercially are satisfactory for this purpose since the alloys themselves have a low coefficient of thermal conductivity and have further desirable corrosion-resistant properties. Alloys such as the copper-nickel alloy known under the Registered Trade Mark "Monel" are also satisfactory. Carbon steels may be used but suffer from low corrosion resistance—a condition which may be corrected by application of a protective coating such as a ceramic enamel. Composite panels may have stainless steel for the side tò be exposed to heat and carbon steel for the cool side. While a flat panel is shown in the drawing, it is obvious that in many installations a housing shaped to conform to a particular apparatus will constitute the embodiment of our invention actually in use.

The surfaces 10 and 11 define a space across which it is desired to restrict thermal conductivity to a minimum. The thickness of this space is dependent upon the particular application. In some cases it will be less than half an inch and in others the thickness will be greater than an inch. The side

[*Price* 3/-]

11 is exposed to the highest temperature, which may be above the softening point of glass. Accordingly, a mat or blanket of high melting point fibres 13 occupies the interior space adjacent the surface 11. The fibres 13 may be of nearly pure silica prepared by subjecting a blanket of alkali borosilicate glass fibres to a heat treatment just below the softening point of the glass to separate into distinct phases the various constituents present. The fibre blanket is then immersed in a hot dilute solution of hydrochloric acid to leach out the alkali and boron constituents of the glass leaving behind nearly pure silica fibres. The silica fibres are then given a heat treatment which draws the structure of the individual fibres together to reduce the porosity thereof and impart strength to the fibres. The fibres 13 may also be formed of aluminium oxide. The fibres 13 are not affected by temperatures which would result in the quick softening of glass. Thus, any heat being transferred through the surface 11 and across the blanket 13 of silica fibres has no effect upon the fibres at temperatures well above the softening point of glass. The blanket of fibres 13 is in contact on its interior surface with a similar blanket of fibres 14 of lower melting point fibres, such as glass or other mineral fibres. The blanket of fibres 14 is in contact with the interior of the surface 10 which is exposed to a lower temperature than the surface 11. This temperature must be below the softening point of the mineral fibres 14 in order to avoid reducing the insulation quality of the panel. During use there is a temperature gradient through the blankets 13 and 14. The boundary between the high melting fibres and the low melting fibres must be at a temperature below the softening point of the low melting fibres used. The blanket of fibres 14 has slightly better thermal insulation qualities if made of glass than the blanket of fibres 13 if made of silica and at the same time is considerably cheaper in price. Thus, we have produced a high-temperature insulation panel which gives the best performance at the lowest cost.

The orientation of the fibres comprising the blankets 13 and 14 is in accordance with that disclosed in co-pending Application No. 17719/52 (Serial No. 715,174). In accordance with the above application, improved insulating quality is conferred by evacuating the space occupied by the fibres and packing the fibres at random with their axes positioned generally parallel to the plane of the surface 10 and 11. Small diameter mineral fibres are preferred to large diameter. While fibres having a filament diameter of more than 1 to 15 microns may be used best results are achieved if the filament diameter is still less. This size filament imparts satisfactory insulation properties even at interior pressures as high as 10 mm. Hg but it is desirable to restrict the interior pressure to 1 mm. Hg or less.

It is well known that fine glass fibres are very fluffy and springy. If not packed in some way, the mats or blankets of fibres are of very low density. While it is not necessary that the fibres be packed to a degree whereby they just occupy the space into which they are to be inserted, we prefer to pre-compact the fibres to this size or to a size just slightly larger than the space they are to occupy. We prefer to accomplish this by the method disclosed in co-pending Application No. 17857/52 (Serial No. 715,175). According to this method a batt of material is heated while under compression to a temperature above the strain point of the glass filaments and below the temperature at which any softening of the glass occurs to cause the batt to retain its compressed form after release of the compressive force.

Glass batts may also be fabricated by substituting glass fibres for cellulose fibres in a conventional paper making machine. In accordance with the process, glass fibres suspended in water are run on to the screen of a Fourdrinier machine where the water is drained off to leave a mat of fibres on the screen. It is preferred to use fibres having a diameter of the order of 2.5 microns in this process. A mat may be built up to the desired thickness by this process and the fibres are naturally oriented with their axes generally in a plane parallel to the plane of the mat faces.

The density desirable in a batt of insulating material for the lower melting point blanket 14 varies according to the diameter of the filaments and is determined by the amount of filaments required to support atmospheric pressure. Coarse fibre must be packed to a greater density than fine fibre. For lower melting point blankets comprising glass filaments whose diameter is a thousandth of an inch or less, we prefer to have a density of the order of 15 lbs. per cu. ft. or, in other words, a specific gravity of about 0.25. It is to be understood that the density of the insulating material is not critical within narrow limits. The insulation quality of the final housing or panel is improved with greater fibre density since radiation losses are reduced as density is increased.

In fabricating a housing or panel in accordance with our invention, we prefer to form an envelope of two metal surfaces which are gas-tight and substantially coextensive. One of these metal surfaces such as the surface 11 is drawn slightly in order to provide clearance from the other metal surface. The two plates are then sealed on three sides as by welding. The batt of insu-

lating material prepared as described above is then inserted in the open fourth side which is then sealed and the envelope evacuated. Before or during the evacuation process, it is highly desirable to subject the housing or panel to a heat treatment to drive off occluded gases.

What we claim is:—

1. A thermal insulation structure comprising a pair of gas-impervious surfaces in spaced, sealed engagement defining an evacuated space, a blanket of high melting point mineral fibres in the evacuated space in engagement with one of the surfaces, and a blanket of mineral fibres having a lower melting point in the evacuated space in engagement with the other surface, the fibres being randomly oriented, each with its axis positioned generally parallel to the plane of the portion of the surface nearest the fibre.

2. An insulation structure as claimed in Claim 1 in which the high melting point fibres are composed of silica and the low melting point fibres are composed of glass.

3. An insulation structure as claimed in Claim 1 or Claim 2 in which the lower melting point blanket comprises glass fibres packed to a specific gravity of 0.25.

4. An insulation structure as claimed in any of the preceding claims in which the gas-impervious surfaces are spaced metal sheets.

5. An insulation structure as claimed in Claim 4 in which the metal sheets are stainless steel.

6. An insulation structure as claimed in Claim 4 in which one of the metal sheets is composed of stainless steel and the other is composed of carbon steel.

7. An insulation structure as claimed in any of the preceding claims in which the pressure in the evacuated space is less than 10 millimeters of mercury.

8. An insulation structure constructed substantially as hereinbefore described with reference to the accompanying drawing.

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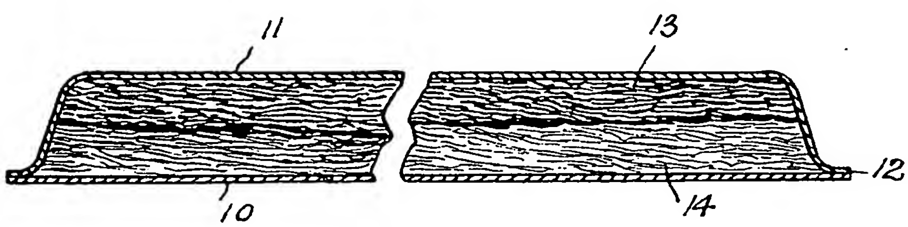
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